

THE GENUS *TETRANEMA* (SCROPHULARIACEAE) IN COSTA RICA, WITH
TWO NEW SPECIES

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ABSTRACT

Two new species of *Tetranema* (Scrophulariaceae) are described from Costa Rica: *T. gamboanum* Grayum & Hammel, known from wet forests on both slopes, and *T. floribundum* Hammel & Grayum, endemic to Cerro Turrubares in the mid-Pacific region. Both are unusual in having a long-stemmed growth habit and red, tubular corollas presumably adapted for pollination by hummingbirds. The new species are most similar, at least in floral morphology, to the Mexican endemic *Tetranema megaphyllum* (Brandege) L.O. Williams. These are the first records of the genus from south of Honduras, and increase the total number of species from four to six.

KEY WORDS: Costa Rica, Scrophulariaceae, *Tetranema*, systematics

A wealth of botanical material gathered during the exploration of a remote region on the Atlantic slope of Costa Rica's Cordillera de Talamanca in April, 1989, included one particularly remarkable collection made by Costa Rican botanist Gerardo Herrera. This collection was remarkable in representing a conspicuous, terrestrial herb--an asterid dicot with bright red, tubular corollas ca. 5 cm long--that we were unable to identify even to the generic level. Though its flowers superficially resembled those of some Acanthaceae known from the region [*Odontonema tubaeforme* (Bertol.) Kuntze, *Razisea spicata* Oerst.], the Herrera collection was soon identified as belonging to Scrophulariaceae. However, the combination of a caulescent, subshrubby growth habit and axillary, long-pedunculate, bracteolate, cymose inflorescences seemed incompatible with any known genus; indeed, we entertained the notion of establishing a new genus to accommodate this collection and other, similar material that has subsequently emerged from Costa Rica.

With respect to their shrublike habit, axillary, cymose inflorescences and red, tubular corollas, the abovementioned Costa Rican collections suggest the genus *Russelia* Jacq., of the monotypic tribe Russeliae. *Russelia* differs, however, in having septicial capsules densely packed with hairs. The Costa Rican material better concords with tribe Cheloneae *sensu* Thieret (1954), characterized by bracteolate,

cymose or racemose inflorescences and sterile posterior stamen filaments. The only members of this group occurring naturally in the Mesoamerican region are the large genus *Penstemon* Schmidel and the oligotypic *Tetranema* Benth. ex Lindl. and *Uroskinnera* Lindl. (though none of these have been recorded from south of Honduras). Each of these three genera includes at least one species with red, tubular, presumably hummingbird-pollinated flowers (see, e.g., Daniel & Breedlove 1992).

Tetranema differs from *Penstemon* and *Uroskinnera* in having axillary and cymose (rather than terminal and racemose or thyrsoïd) inflorescences and much reduced sterile stamens (staminodes); it further differs from *Uroskinnera* in having distinct sepals, and from *Penstemon* in having loculicidal capsules. In all of these critical details, the Costa Rican material accords perfectly with *Tetranema*. Moreover, the seeds of the one Costa Rican collection examined in this regard (Figure 2) are a very convincing match for those of *Tetranema roseum* (M. Martens & Galeotti) Standl. & Steyerl., as illustrated by Beaufort-Murphy (1983: Pl. 4G) (who, unfortunately, did not study *Uroskinnera* or *Penstemon*).

Our initial attempts to identify the Costa Rican *Tetranema* collections to genus level were thwarted by our reliance on Standley & Williams's (1973) *Flora of Guatemala* Scrophulariaceae treatment. In their generic key (p. 321), the leads are inverted in the couplet purporting to separate *Tetranema* from *Uroskinnera* and *Penstemon* (as pointed out by Daniel & Breedlove 1992). Furthermore, the three *Tetranema* species attributed to Guatemala are all quite unlike the Costa Rican material in being acaulescent or short-stemmed herbs with campanulate, white or purple (*vide* Standley & Williams) corollas.

Tetranema has heretofore been considered a genus of four species, ranging from southern México (Puebla) to Honduras (Méndez-Larios & Villaseñor 1995). *Tetranema roseum*, the most wide-ranging species, is of modest horticultural repute as a glasshouse plant, with at least two cultivars available commercially under the name "Mexican foxglove" (Morrison 1981).

The Costa Rican material of *Tetranema* is here treated as comprising two species new to science, bringing the generic total to six. *Tetranema gamboanum* Grayum & Hammel is represented by the Herrera collection from the Atlantic slope and several subsequent collections from wet-forest sites on the Pacific slope, while *T. floribundum* Hammel & Grayum is known only by three collections from Cerro Turrubares, an isolated peak in the central Pacific region.

TETRANEMA GAMBOANUM Grayum & Hammel, *spec. nov.* TYPE: COSTA RICA. Puntarenas: Cantón de Osa, Fila Costeña, cabeceras del Río Piedras Blancas, Cerro Anguciana, 8° 49' 12" N, 83° 11' 15" W, 900 m, 7 Dec 1993 (fl., fr.), Aguilar *et al.* 2700 (HOLOTYPE: INB!; Isotypes: BM!, CAS!, CR!, F!, MEXU!, MO!, NY!, US!). Figures 1-2.

Species cum *Tetranemata megaphyllo* (Brandege) L.O. Williams optime congruens sed differt foliis apice longiacuminatis bracteis inflorescentia brevioribus corolla longiore lobis corollae multo longioribus.

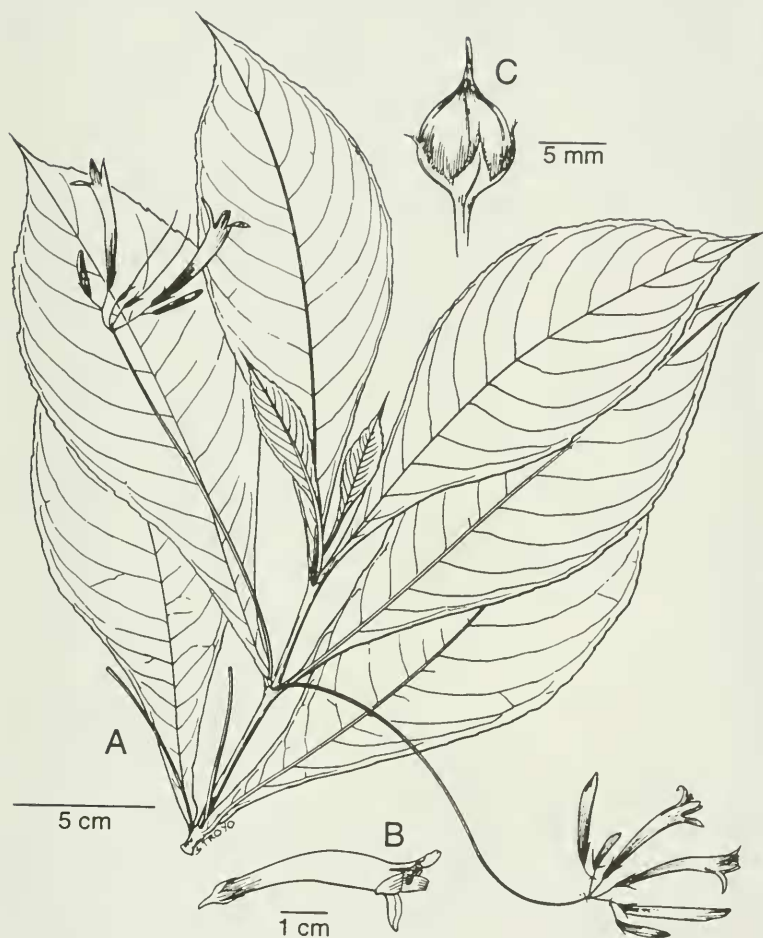


Figure 1. *Tetranema gamboanum*. A. flowering shoot (Aguilar et al. 2700); B. flower (Aguilar et al. 2700); C. fruit (Hammel et al. 19429).

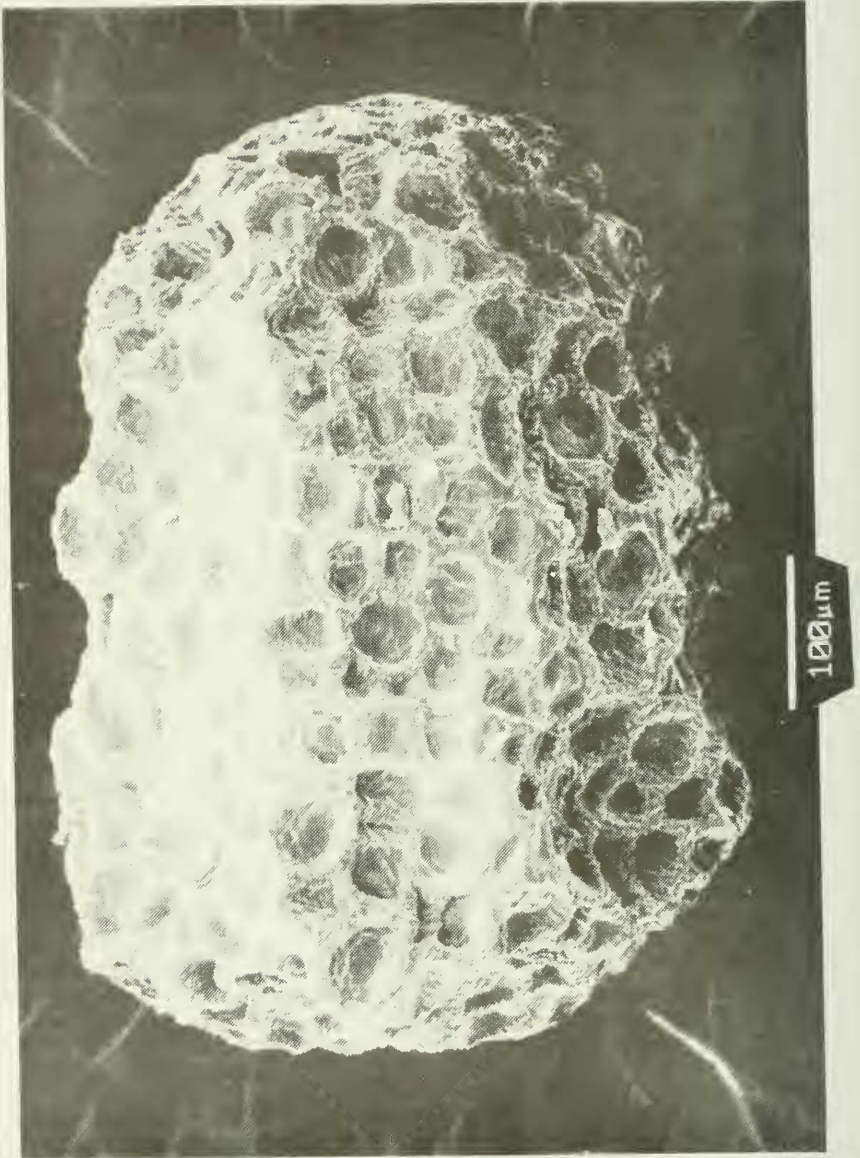


Figure 2. *Tetranema gamboanum* (Hammel et al. 19542), seed; $\times 150$ (photo by Betty Strack).

Erect, decumbent-based herbs 1-2+ m tall. Internodes to at least 11 cm long, strigulose when young. Petioles obsolete to ca. 1 cm long, strigulose, canaliculate above, the margins ciliate proximally, the hairs extending in a line across the node. Leaves 14-31 × 5-11 cm, elliptical to oblanceolate or spatulate, long-acuminate at apex, attenuate to the base (where decurrent onto the petiole), the margins ± coarsely serrate, glabrous above or with few, distant hairs along the midrib and major veins (especially proximally), pubescent along the veins below, midrib often falcate, primary lateral veins ca. 9-13 per side, prominulous on both sides when dry. Inflorescences axillary, cymose; peduncle 9-24 cm long, divergent, green, quadrangular with the angles narrowly winged. Flowers ca. 2-12 per inflorescence, bracteate, the bracts 0.5-2.0 mm long, subulate to narrowly triangular, ciliate on margins; pedicels ca. 9-11 mm long at anthesis, to ca. 20 mm in fruit, glabrous; calyx 5-merous, divided nearly to base, the lobes ca. 3-5 mm long at anthesis (to ca. 6 mm in fruit), ± narrowly to broadly ovate, imbricate, ± cornute apically, ciliate on margins; corolla ca. 4.9-5.5 cm long, scarlet, tubular, slightly curved (convexly) upward and gradually expanded distally, glabrous throughout or (*Herrera & Chacón 2644*) with flat hairs at the mouth and onto the lower lobes, the lobes 4, 11-13 × 3.0-3.5 mm, imbricate, lanceolate, the 3 lower ones obtuse to rounded apically and spreading-reflexed, the upper one emarginate and slightly wider; fertile stamens 4, exerted from the throat (but not exceeding the upper corolla lobe); filaments attached at base of corolla tube, glabrous, ± dilated toward base; anther sacs 0.8-1.0 mm long, confluent apically and becoming divergent, glabrous; staminode ca. 1.5-2.0 mm long; ovary 3-4 mm long, narrowly ovoid, glabrous; style exerted, glabrous; stigma clavate to funnelliform, hollow, the rim papillose; fruit a loculicidal capsule, ca. 6-9 mm long, subglobose-apiculate; seeds ca. 0.6-0.7 × 0.45 mm, oblong, amber to black, densely foveolate.

Additional specimens examined: COSTA RICA. Limón: Cordillera de Talamanca, entre Cerro Muchilla y Cerro Avioneta, cabeceras de Río Suruy, Fila Matama, 9° 47' 25" N, 83° 06' 30" W, 550 m, 17 Apr 1989 (fl.), *Herrera & Chacón 2644* (BM,CR,INB,MEXU,MO,USJ). Puntarenas: Cantón de Osa, upper head waters of Río Piedras Blancas, W slopes of Cerro Anguciana, Fila Cruces, 8° 49' 12" N, 83° 11' 09" W, 950-1,150 m, 10 Dec 1993 (fl.), *Grayum 10663* (CAS,BM,CR,F,INB,MEXU,MO); same locality, 7 Dec 1993 (fl., fr.), *Hammel et al. 19200* (CR,INB,F,MO). San José: Cantón de Pérez Zeledón, Fila Costeña, Fila Tinamastes, por la carretera entre Dominical y San Isidro, 9° 18' 43" N, 83° 46' 19" W, 950 m, 3 Feb 1994 (fl., fr.), *Hammel et al. 19429* (COL,CR,INB,MICH,MO,TEX); same locality, 28 Mar 1994 (fl., fr.), *Hammel et al. 19542* (CR,INB,MO; live at MO).

Tetranema gamboanum is endemic to Costa Rica, where it is known by a single collection from the Atlantic slope of the Cordillera de Talamanca (Fila de Matama) at 550 m elevation, and from two widely separated sites in the Pacific Fila Costeña at ca. 900-1,000 m (Figure 3). All of these stations appear to lie in the Premontane Rain Forest Life Zone of the Holdridge system (*cf.* Tosi 1969). Flowering material of *T. gamboanum* has been collected from December through April.

As mentioned previously, Costa Rican material of *Tetranema* does not concord with any of the three species treated in the *Flora of Guatemala* (Standley & Williams

1973). It does, however, compare reasonably well with the Chiapan endemic *T. megaphyllum* (Brandegee) L.O. Williams, at least in terms of gross floral morphology. The original description of *Allophyton megaphyllum* Brandegee (1914) specified tubular, red corollas ("Corollae tubus cylindraceus . . . Corollae coccineae") that "resemble those of *Russelia*," and subsequent descriptions agree on this point. This is the only *Tetranema* species from north of Costa Rica that has tubular corollas, though those of *T. evolutum* Donn. Sm. may be red (*vide* Méndez-Larios & Villaseñor 1995; Standley & Williams described them as "bright purple").

Tetranema gamboanum would seem to differ from *T. megaphyllum* in comprising taller (1-2+ m), coarser plants. Although the specimens of the latter species studied by Brandegee (1914) were "not complete enough to give the size of the plant," the leaves were said to be "crowded," suggesting that the plants may have been short-stemmed. Pennell (1925), the first to ally the "most remarkable" *Allophyton megaphyllum* with *Tetranema* (using the name *Allophyton* Brandegee for the entire group), stated that "all the species of *Allophyton* have short stems," more specifically, "1 dm long or less." Pennell cited three duplicates of a topotype collection (*Purpus* 7921) not cited by Brandegee. Méndez-Larios & Villaseñor (1995), citing three additional collections not seen by previous authors, characterize *T. megaphyllum* as "la especie con desarrollo vegetativo más vigoroso"; nevertheless, they describe it as having "tallos muy reducidos," 25-40 cm tall.

Although we have been unable to obtain the holotype of *Tetranema megaphyllum* on loan, we have studied an isotype (*Purpus* 6855 [NY]), as well as the NY duplicate of the topotype cited by Pennell (1925). While neither of these specimens bears label data indicating either the habit of the plants or the color of the corollas, the following differences from *T. gamboanum* are manifest: *T. megaphyllum* has inflorescence bracts to ca. 10 mm long and corollas ca. 2.5-3.6 cm long with rounded, apparently forward-directed lobes ca. 2-4 mm long; *T. gamboanum*, on the other hand, has inflorescence bracts to ca. 2 mm long and corollas ca. 5 cm or more long with elongate, spreading-reflexed lobes ca. 11-13 mm long. These observations are corroborated by Méndez-Larios & Villaseñor's (1995) description of *T. megaphyllum*.

The occurrence of *Tetranema gamboanum* on both the Atlantic and Pacific slopes has innumerable precedents in the Costa Rican flora. The lone collection from the Atlantic slope (*Herrera & Chacón* 2644) is essentially a perfect match for the Pacific material, except for the unusual corolla hairs noted in the description. Whether or not these hairs are characteristic of Atlantic populations, and thus potentially indicative of infraspecific rank, cannot be decided without additional material.

Tetranema gamboanum is probably more widespread in Costa Rica than our scattered records indicate; it may also yet be found in Panamá. Although it is locally more or less abundant, none of the three known stations lies within a protected area. This appears to be a species of relatively undisturbed habitats.

We take great pleasure in dedicating this new species to William Gamboa Elizondo (1958-) of Las Mellizas de Coto Brus, Costa Rica, who has participated enthusiastically in virtually every major botanical expedition into the Cordillera de Talamanca since 1983 as cook, porter, scout, negotiator, and occasional collector.

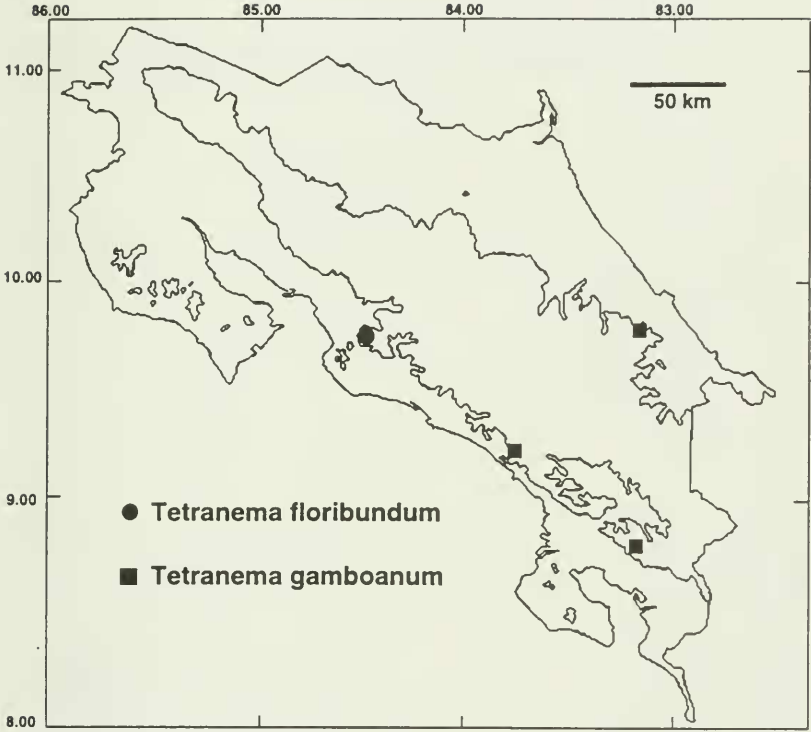


Figure 3. Distribution of *Tetranema* in Costa Rica (500 m contour is indicated).

TETRANEMA FLORIBUNDUM Hammel & Grayum, *spec. nov.* TYPE: COSTA RICA. San José: lado N de Cerro Turrubares, al S de San Rafael por Quebrada Pital, 9° 48' 05" N, 84° 27' 52" W, 1,200-1,300 m, 5 Jan 1996 (fl., fr.), Hammel, Jiménez, & Morales 20068 (HOLOTYPE: INB!; Isotypes: BM!, CR!, F!, MO!). Figure 4.

Species ex affinitate *Tetranematis megaphylli* (Brandege) L.O. Williams et *T. gamboani* Grayum & Hammel, ab utroque inflorescentiis omnibus (8-)14-30-floris tubo corollae intus ventraliter in longitudinem pubescenti distincta.

Erect, decumbent-based herbs (0.35-)0.80-2.00 m tall, often rooting at decumbent nodes. Internodes to at least 5 cm long, densely matted-, arachnoid-, or woolly-pubescent when young. Petioles essentially obsolete, the often undulate margin of the leaf blade reaching nearly to the node. Leaves 21.0-23.5 × 9-13 cm, broadly elliptic to oblanceolate or spatulate, rounded, abruptly acute or short-acuminate at apex, acute to mostly concavely and abruptly attenuate to the base, the margins coarsely serrate to undulate-toothed, glabrous above except on the midrib at the very base, strigulose on the midrib and main veins below and minutely scaly (and thus shiny, when dry) throughout the abaxial leaf surface, midrib occasionally falcate, primary lateral veins 8-10(-11) per side, prominent below. Inflorescences axillary, cymose; peduncle 13-23 cm long, purple, quadrangular with the angles narrowly winged. Flowers ca. (8-)14-30 per inflorescence, bracteate, the bracts 1-5 mm long, narrowly triangular, ciliate (often only at base) on margin; pedicels ca. 10 mm long at anthesis, to ca. 20 mm in fruit, glabrous; calyx 5-merous, divided nearly to base, the lobes 2-3 mm long at anthesis (to 4 mm in fruit), broadly ovate, ± cornute apically, ciliate on margins; corolla 2.6-3.5 cm long, red, tubular, gradually slightly curved (convexly) upward and expanded distally, glabrous externally, internally pubescent with a narrow band of flat, yellow hairs (to ca. 1 mm long) on the ventral surface of the tube from near the base to the mouth and often all along the median lower lobe, the lobes 4, ca. 13 × 2.5-5.5 mm, ± lanceolate, the 3 lower ones rounded apically and spreading-reflexed, the upper one emarginate and slightly wider; fertile stamens 4, exerted from the throat (but held just below the upper corolla lobe and not exceeding it); filaments attached at the base of the corolla tube; anther sacs 0.8-0.9 mm long, confluent apically (where attached to the filament), divergent at dehiscence (full length) and then broadly elliptic, glabrous; staminode ca. 0.5 mm long; ovary ca. 3.5 mm long, narrowly ovoid, glabrous; style exerted (with the stamens), glabrous; stigma clavate, hollow; fruit to ca. 8 mm (immature), ovoid.

Additional specimens examined: COSTA RICA. San José: Cantón de Turrubares, Z. P. Cerros de Turrubares, Potenciana arriba, cerca del Cerro Turrubares, 9° 48' 00" N, 84° 27' 10" W, 1,600 m, 4 Mar 1993 (fl., fr.), Jiménez et al. 1155 (BM, CR, INB, MO); Z. P. Cerros de Turrubares, Cerros de Puriscal, sector San Rafael, Sitio Cerro Pelón, 09° 49' 00" N, 84° 28' 50" W, 1,200 m, 6 Dec 1991 (fl.), Zúñiga 599 (INB).

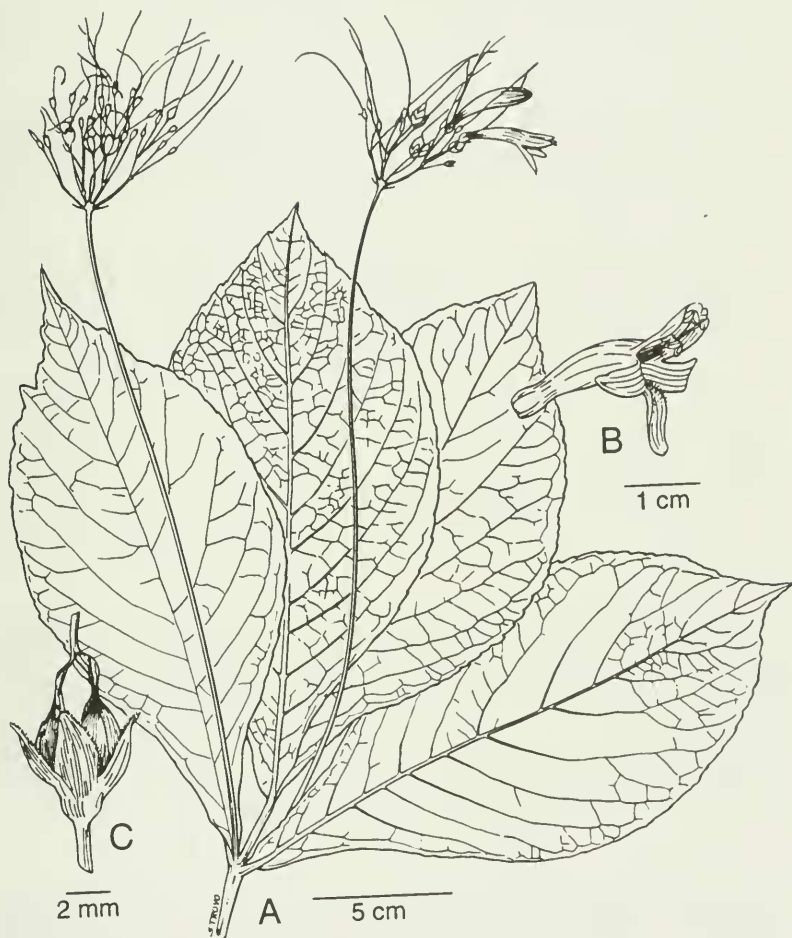


Figure 4. *Tetranema floribundum*. A. flowering shoot (Jiménez et al. 1155); B. corolla (Hammel et al. 20068); C. fruit (Jiménez et al. 1155).

Tetranema floribundum is endemic to Costa Rica, where it is known only from Cerro Turrubares, an isolated peak in the central Pacific region, at 1,200-1,600 m elevation (Figure 3). This region apparently corresponds to the Lower Montane Rain Forest Life Zone of the Holdridge system (cf. Tosi 1969). The three flowering collections of *T. floribundum* are from December, January, and March.

The specific epithet of *Tetranema floribundum* reflects the fact that it has more flowers (ca. 14-30) per inflorescence, on average, than any other known *Tetranema* species (*T. roseum* may have as many as 20). It differs additionally from *T. gamboanum* and *T. megaphyllum*, the only other species with red, tubular corollas, in having the corolla tube internally pubescent along the ventral surface. The corollar pubescence of the sole Atlantic slope collection of *T. gamboanum*, discussed previously, does not extend into the tube. *Tetranema floribundum* is further distinguished from *T. gamboanum* in having (as *T. megaphyllum*) merely acute to short-acuminate (rather than long-acuminate) leaf apices and smaller corollas, and from *T. megaphyllum* in having (as *T. gamboanum*) longer stems and generally larger corollas with relatively and absolutely much longer, spreading-reflexed lobes.

It may seem unusual that *Tetranema* populations on Cerro Turrubares, in the central Pacific region of Costa Rica, should differ specifically from populations in the southern Pacific region, while the latter populations should be conspecific with material from the Atlantic slope (as discussed under *T. gamboanum*). Cerro Turrubares, however, is relatively high and quite isolated, and is known to harbor other endemic plant species (cf. Burger & Jiménez 1994). *Tetranema floribundum* occurs at slightly higher elevations and, ostensibly, in a different life zone than *T. gamboanum*.

Tetranema floribundum should presently be considered an endangered species, since it is known from just a few populations in a site that has already been seriously degraded by human activity. Two of the three collections were made within a protected area (Zona Protectora Cerro de Turrubares), but from a region dominated by pastures.

Both of the new Costa Rican *Tetranema* species described herein will come out to *T. megaphyllum* in the key of Méndez-Larios & Villaseñor (1995). The distinguishing characteristics of these three species may be summarized as follows:

1. Corolla lobes ca. 2-4 mm long, < 1/5 the total corolla length, apparently directed forward; floral bracts ca. 6-10 mm long; stems ca. 0.25-0.40 m tall; leaf apex acute to short-acuminate; inflorescence 3-10-flowered; corolla ca. 2.5-3.6 cm long, glabrous throughout; Chiapas. *T. megaphyllum*.
- 1' Corolla lobes ca. 11-13 mm long, > 1/5 the total corolla length, spreading-reflexed; floral bracts 0.5-5.0 mm long; stems (0.35-)0.80-2.00 m tall; Costa Rica. (2)
2. Inflorescence many- (14-30-) flowered, the peduncle purple; corolla 2.6-3.5 cm long, pubescent within in a band of flat, yellow hairs along the entire ventral surface and onto the lower lobe; leaf apex rounded to short-acuminate; Cerro Turrubares. *T. floribundum*

- 2' Inflorescence few- (2-12-) flowered, the peduncle green; corolla ca. 4.9-5.5 cm long, glabrous throughout or (rarely) pubescent on lower lobe and at mouth; leaf apex long-acuminate; Fila Costeña and Atlantic slope of Cordillera de Talamanca *T. gamboanum*

The recent discovery of *Tetranema* in Costa Rica is surprising, especially since both species comprise shrubby, understory plants with large, vividly scarlet corollas. Though the distribution of the genus in Costa Rica appears spotty, *T. gamboanum*, at least, may be locally abundant. At the Tinamastes site, a sizeable population occurs right at the roadside along a moderately well-botanized route (San Isidro de El General to Dominical).

It is likely that earlier Costa Rican collections of *Tetranema*, not seen by us, will yet be discovered filed as undetermined, or misdetermined, in some of the many scattered herbaria housing Costa Rican material. As in the case of *Ticodendron* (Ticodendraceae), another conspicuous Central American plant described only recently, the belated recognition of *Tetranema* in Costa Rica is "perhaps explainable by the fact that although it looks very much like something well known [e.g., an Acanthaceae, *Scutellaria*, or *Russelia*], it really is something different" (Hammel & Burger 1991: 92).

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